Protecting Kentucky's Water – Be a Water Scientist
High School

Tapping Into Our Local Water Supply

Adapted from "How Water Is Cleaned", ", found in ***Always a River***, EPA, 1992, pages 193-197.

Standards

Science Applications and Connections: Students will investigate how science can be used to solve environmental quality problems and use science to investigate natural and human-induced hazards.
Practical Living: PL-H-3.3.2, Students will analyze community health standards and regulations (e.g., air/water quality, immunization, health and safety protection of citizens).

Activity Description

Students will investigate where local water originates and what happens to it before it arrives at their homes.

Materials

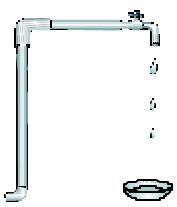
- Access to computers, telephone and library materials for research
- List of resource people to contact about local water
- Local watershed maps (at least 4 to be shared by groups of students)
- "How a Water Treatment System Works" handout, included
- Bucket containing 5 liters of "swamp water" (or add 2 1/2 cups of dirt or mud to 5 liters of water)
- One 2-liter plastic soda bottle with its cap
- Two 2-liter plastic soda bottles — one bottle with the top removed and one bottle with the bottom removed.
- One 1.5 liter (or larger) beaker or another soft drink bottle bottom
- 2 tablespoons alum (potassium aluminum sulfate), found at pharmacy
- Fine sand (about 800 milliliters in volume)
- Coarse sand (about 400 milliliters in volume)
- Small pebbles (about 400 milliliters in volume)
- Large beaker or jar (500 milliliters or larger)
- Small piece of flexible nylon screen (approximately 5 centimeters x 5 centimeters)
- A tablespoon, a rubber band and a stopwatch

Length of Lesson

1 class period

Vocabulary Words

Clean Water Act—the Federal Water Pollution Control Act of 1972, Public Law 92-500, is a law passed by the United States Congress, in 1972, that created guidelines for states to follow concerning water quality.
EPA standards—national standards for a variety of environmental programs that have been researched and set by the Environmental Protection Agency (EPA), which was established by the United States Congress in 1970, in an effort to control pollution of air, land and water.
Wastewater treatment plant—a large facility that treats wastewater from homes and industry to a point where it can be safely discharged into the environment.
Watershed—region draining into a river, river system, or body of water.
Water treatment plant—a facility that cleans and purifies water pumped from wells, rivers, and streams prior to distributing the water to customers.



Tapping Into Our Local Water Supply, *continued*

Essential Question	**How can I tell if my water is clean?**
Guiding Questions	• Where do we get our drinking water? • What happens to it before it arrives in our homes? • What is a watershed?
Skills Used	Observe, Research, Organize, Compare, Speculate, Investigate, Discuss, Communicate

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Preparation

NOTE: Depending on the amount of time allotted to study this topic, this activity may be designed in different ways. The shortest way will be presented, but an extension is given that may be used to lengthen the activity and give students time to investigate their local watershed.

Step 1: Prior to beginning this activity, locate a Kentucky watershed map. A map may be obtained by contacting the local Conservation District or Soil Conservation Service office. A detailed watershed map may be obtained for about $6 from Kentucky Geological Survey, University of Kentucky, Lexington, 859-257-3896. Also, contact the local water company to find the names and numbers of people to contact in the community to learn more about local drinking water sources and quality.

Step 2: Refer to the materials section on the previous page for a list of supplies needed. Collect the equipment and materials before time for students to arrive. Copy the included handout: "How a Water Treatment System Works".

Activity

Step 1: Begin this activity by asking students where water originates. If, depending on student responses, you feel it is necessary, review the hydrologic cycle, and the amount of water found on Earth with students. Two activities from the middle school section of this publication address this topic thoroughly.

Step 2: Show students a Kentucky watershed map. Explain to students that watersheds are areas of land which drain into a stream, river, lake, or another body of water. Explain that within a single watershed, all of the precipitation drains to a given point in the same body of water, and that the elevation of the land determines the area of the watershed, with the highest ground forming the boundaries. Tell students that they are part of the largest watershed in the United States — the Mississippi River watershed — but that they are also located in much smaller watersheds that would include the closest ditch that water drains into after a large rain.

Tapping Into Our Local Water Supply, *continued*

Step 3: Pass out the watershed maps and have students move into smaller groups so they can locate their school on the map. Have students name the closest stream to their school. Next, ask students to follow the small stream to the next largest stream. Continue this until they arrive at a large lake, or the largest river on the watershed map.

Step 4: Explain to students that there are water quality guidelines that set the standards for local water companies to follow. Explain that these standards were developed by the Environmental Protection Agency and state agencies to keep our water safe for human consumption. (Refer to "Side Topics" for specific web sites that contain more information about water legislation.)

Step 5: Pour about 1.5 liters of "swamp water" into a 2-liter bottle. Have students describe the appearance and smell of the water. Tell students that, as a class, they will simulate what the local water companies must do to filter impurities out of the water and disinfect it so it is safe for us to drink when it reaches our homes.

Step 6: AERATION. Place the cap on the bottle of swamp water and shake the water vigorously for 30 seconds. Continue the aeration process by pouring the water into either one of the cutoff bottles, then pouring the water back and forth between the cutoff bottles 10 times. Ask students to describe any changes they observe. Pour the aerated water into a bottle with its top cut off. Explain that this process allows gases trapped in the water to escape and adds oxygen to the water.

Step 7: COAGULATION. Add approximately 2 tablespoons of alum crystals to the water. Slowly stir the mixture for 5 minutes. Explain that particles suspended in the water will clump together with the alum to produce floc.

Step 8: SEDIMENTATION. Allow the water to stand undisturbed in the bottle. Have students observe the water at 5-minute intervals for a total of 20 minutes and write their observation with respect to changes in the water's appearance. The floc should settle to the bottom.

NOTE: This would be a good time for students to begin locating information about the local drinking water supply. The local water company should have an Internet web site or a local telephone number so students might contact someone to find out where local water comes from, where it is stored, and where the local drinking water treatment and wastewater treatment plants can be found.

Side Topics for Student and Teacher Research

Visit the following web site to learn more about legislation that has affected Kentucky's drinking water quality by following links from the Environmental Timeline that was developed by the Kentucky Environmental Quality Commission: http://www.kyeqc.net/thirty/time/yeartime.html.

Also visit EPA's water web site (http://www.epa.gov/ebtpages/water.html) and follow links to research and learn more about drinking water standards, water pollutants, etc.

Visit the following web site for timely information about water quality issues in Kentucky: http://www.kyeqc.net/pubs/soke01/slide.html.

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Step 9: FILTRATION. While the floc is settling, construct a filter from the bottle with its bottom cut off:

- Attach the nylon screen to the outside neck of the bottle with a rubber band. Turn the bottle upside down and pour a layer of pebbles into the bottle — the screen will prevent the pebbles from falling out of the neck of the bottle.
- Pour the course sand on top of the pebbles.
- Pour the fine sand on top of the course sand.
- Clean the filter by slowly and carefully pouring through 5 liters (or more) of the clean tap water. Try not to disturb the top layer of sand as you pour the water.

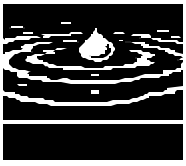
After a large amount of the floc has settled, carefully — and without disturbing the sediment — pour the top two-thirds of the swamp water through the filter. Collect the filtered water in the beaker. Pour the remaining (one-third bottle) of swamp water into the collection bucket. Compare the treated and untreated water. Ask students whether treatment has changed the appearance and smell of the water.

Step 10: DISINFECTION. Inform students that a water treatment plant would, as a final step, disinfect the water (e.g., would add a disinfectant such as chlorine) to kill any remaining disease-causing organisms prior to distributing the water to homes. Therefore, the demonstration water is not safe to drink.

Step 11: Ask students the following questions to trigger discussion of what they observed:

- What was the appearance of the original swamp water?
- Did the aeration process change the appearance or smell of the water? (If the original sample was smelly, the water should have less odor. Pouring the water back and forth allowed some of the foul-smelling gases to escape to the air of the room.)
- How did sedimentation change the water's appearance? Did the appearance of the water vary at each 5-minute interval? (The rate of sedimentation depends on the water being used and the size of alum crystals added. Large particles will settle almost as soon as stirring stops. Even if the water contains very fine clay particles, visible clumps of floc should form and begin to settle out by the end of the 20-minute observation period.)
- How does the treated water (following filtration) differ from the untreated swamp water? (The treated water should look much clearer and have very little odor.)

Step 12: After the experiment has been concluded, distribute copies of the "How a Water Treatment System Works" handout. Compare the steps you have just performed with those in a water treatment plant.



Extensions/Variations

A more complete study of the local watershed may be conducted, and a model of the local watershed built so on-site study can take place to determine how the water flows and possible causes of point and nonpoint source pollution in the area. Contact the local 4-H Agent to obtain a copy of the "Watershed Construction Manual", or visit the following web site: http://www.slo4h.org/!conman.html. For a general study of watersheds and point and nonpoint sources of pollution, an Enviroscape model may be borrowed from several locations listed in the Teacher Fact Sheets.